

**U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Sistrurus catenatus catenatus*

COMMON NAME: eastern massasauga rattlesnake

LEAD REGION: Region 3

INFORMATION CURRENT AS OF: May 12, 2010

STATUS/ACTION

☐ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

☐ New candidate

☒ Continuing candidate

☐ Non-petitioned

☒ Petitioned - Date petition received: May 11, 2004

☐ 90-day positive - FR date: May 11, 2005

☐ 12-month warranted but precluded - FR date: May 11, 2005

☐ Did the petition requesting a reclassification of a listed species? No

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this subspecies has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations, and essential litigation-related, administrative, and program management tasks. It has recently come to our attention that declines have continued or may be accelerating in several states. Thus we are monitoring the status of this subspecies to determine if a change in listing priority is warranted. For information on listing actions taken, see the discussion of "Progress on Revising the Lists," in the current CNOR, which can be viewed on our Internet website (<http://endangered.fws.gov/>).

☐ Listing priority change

Former LP: ☐

New LP: ☐

Date when the species first became a Candidate (as currently defined): October 25, 1999

- ___ Candidate removal: Former LP: ___
- ___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
- ___ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
- ___ F – Range is no longer a U.S. territory.
- ___ I – Insufficient information exists on biological vulnerability and threats to support listing.
- ___ M – Taxon mistakenly included in past notice of review.
- ___ N – Taxon does not meet the Act’s definition of “species.”
- ___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Reptiles, Family Viperidae, Subfamily Crotalinae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: United States – Illinois , Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wisconsin; Canada – Ontario.

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE:

United States:

Illinois - Clinton, Cook, Fayette, Knox, Lake, Madison, Piatt, Warren, and Will Counties.

Indiana - Allen, Carroll, Elkhart, Fulton, Kosciuscko, Lagrange, LaPorte, Marshall, Noble, Porter, Pulaski, St. Joseph, Steuben, and Tippecanoe Counties

Iowa - Black Hawk, Bremer, Buchanan, Chickasaw, Clinton, Louisa, Muscatine, Pottawattamie, and Scott Counties

Michigan - Alcona, Allegan, Alpena, Arenac, Barry, Berrien, Calhoun, Cass, Cheboygan, Clinton, Crawford, Eaton, Genesee, Grand Traverse, Hillsdale, Iosco, Jackson, Kalamazoo, Kalkaska, Kent, Lapeer, Lake, Lenawee, Livingston, Mackinac, Macomb, Manistee, Mason, Midland, Missaukee, Montcalm, Muskegon, Newaygo, Oakland, Presque Isle, Roscommon, Saginaw, St. Joseph, Van Buren, Washtenaw, and Wayne Counties

Minnesota - Goodhue, Houston, Wabasha, and Winona Counties

Missouri - Chariton, Holt, Linn, and Livingston Counties

New York - Genesee and Onondago Counties

Ohio - Ashtabula, Champaign, Clark, Erie, Fairfield, Greene, Licking, Montgomery, Trumbull, Warren, Wayne, and Wyandot Counties

Pennsylvania - Butler, Mercer, and Venango Counties

Wisconsin - Buffalo, Chippewa, Columbia, Crawford, Jackson, Juneau, LaCrosse, Monroe, Pepin, Rock, Trempealeau, Walworth, and Wood Counties

Canada:

Ontario - Bruce, Essex, Grey, Manitoulin, Middlesex, Muskoka, Niagara, Parry Sound, Simcoe, and Sudbury districts

LAND OWNERSHIP: The eastern massasauga rattlesnake is found on both public and private land (approximately 59 percent of the populations occur wholly or in part on public land). The majority of public land is State managed, although populations also occur on county and U.S. Army Corps of Engineers lands. Massasauga rattlesnake populations also occur at Squaw Creek National Wildlife Refuge (NWR), Swan Lake NWR, Trempealeau NWR, and possibly the LaCrosse District of the Upper Mississippi National Wildlife and Fish Refuge. Necedah NWR has been conducting studies on potential reintroduction techniques.

LEAD REGION CONTACT: Jessica Hogrefe, 612-713-5346, Jessica_Hogrefe@fws.gov

LEAD FIELD OFFICE CONTACT: Chicago Ecological Services Field Office, Mike Redmer, 847-381-2253, Mike_Redmer@fws.gov or Kris Lah at Kristopher_Lah@fws.gov.

BIOLOGICAL INFORMATION: See the 1998 Status Assessment for further information (available on the Web at: http://www.fws.gov/midwest/Endangered/reptiles/eama_sa.pdf).

Species Description – Eastern massasauga rattlesnakes are small snakes with thick bodies, heart-shaped heads and vertical pupils. The average length of an adult is about two feet. Adult massasaugas are gray or light brown with large, light-edged chocolate brown blotches on the back and smaller blotches on the sides. The snake's belly is marbled dark gray or black and there is a narrow, white stripe on its head. Its tail has several dark brown rings and is tipped by gray-yellow horny rattles. Young snakes have the same markings as adults, but are paler than adults and the rattle is represented by a single "button."

Taxonomy – *Sistrurus catenatus*, one of three species of rattlesnake within the genus *Sistrurus*, has three recognized subspecies: *S. c. catenatus* (eastern massasauga), *S. c. tergeminus* (western massasauga), and *S. c. edwardsii* (desert massasauga) (Gloyd 1940, Minton 1983, p. 332.1-332.2), Conant and Collins 1998). *S. c. catenatus*, described by Rafinesque in 1818, has a variety of common names: eastern massasauga rattlesnake, eastern massasauga, prairie rattlesnake, spotted rattler, and swamp rattler (Minton 1972).

Subspecies delineations can often be confusing, depending upon the resolution of the data employed for analysis. Furthermore, *S. c. catenatus* supposedly intergrades with *S. c. tergeminus* in Missouri, southwestern Iowa, Kansas, and Oklahoma (Conant and Collins 1998). Recent analyses of the *S. catenatus* complex using mitochondrial genes indicate a deep division between the eastern form and the remaining two subspecies. However, this pattern has not been confirmed using nuclear genes. Thus, while mitochondrial divergences between the two groups are on the order of those observed between species, taxonomic issues remain as previously

defined (Michael Douglas, Illinois Natural History Survey, pers. comm. April 2008).

Unless or until peer reviewed genetic studies prove differently, the Service will continue to follow the distribution described in published literature (as described in Conant and Collins 1998) and will consider all *Sistrurus catenatus* populations found north and east of the Missouri River to be *S. c. catenatus* or the eastern massasauga subspecies as the candidate listing entity.

Habitat – Eastern massasauga occupies shallow wetlands and adjacent upland habitat. Suitable wetland habitat includes peatlands, marshes, sedge meadows, and swamp forest; typical upland habitat includes open savannas, prairies, and old fields. A high water table with places to hibernate such as crayfish burrows or rock crevices is also an important component of the habitat of this species. Seasonal use of these habitats varies across the range of the subspecies.

Historic vs Current Range - Although the current range of eastern massasauga resembles the subspecies' historical range, the geographic distribution has been restricted by the loss of the subspecies from much of the area within the boundaries of that range. Approximately 40 percent of the counties that were historically occupied by eastern massasauga no longer support the subspecies. The eastern massasauga is currently listed as endangered or threatened in every state or province where it occurs except for Michigan, where it is designated as a species of special concern.

Population Estimates/Status - Complete demographic information is not available across the range of the subspecies; however, information regarding the historical and current number of populations, recruitment potential, distribution and proximity of subpopulations, and quantity and quality of habitat give an indication of the subspecies' long-term viability (Szymanski 1998, pp. A6-A17). Each state and Canadian province across the range of eastern massasauga has lost more than 30 percent of their historic populations, and most areas have lost more than 50 percent of their historic populations. Furthermore, less than 35 percent of the remaining populations are thought to be secure. The Service is working with several experts and partner organizations to complete an extinction risk model for the subspecies. Though this model will not provide population numbers, it should give a better indication of the long term viability of the subspecies than is currently available.

THREATS: See the 1998 Status Assessment for further information.

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Habitat loss is an important factor in the decline of eastern massasauga. The effects of past, widespread wetland loss continue to impact eastern massasauga populations. Development and agricultural practices continue to cause habitat loss, although to a lesser degree than in the past. Habitat loss increases the distance between populations and can isolate seasonally used habitats within individual populations.

Destruction or modification of habitat is affecting at least 50 populations rangewide. A few examples are as follows. In Illinois, the Des Plaines River Valley population has been fragmented into smaller subpopulations isolated by development or otherwise unsuitable habitat

(Mierzwa 1993, p. 67). In Michigan, a major residential development, at the Green/Union Lakes site in Oakland County, eliminated much of the existing habitat and severely degraded the remaining habitat (Legge 1996). At Wixom, Michigan, both wetland and upland habitat were degraded by agricultural practices and highway construction (Legge 1996). Similarly, in Bremer County, Iowa, a golf course is encroaching on massasauga habitat (Christiansen 1993, p. 8). In Wisconsin, cranberry operations are potential threats to massasauga populations (Cathy Carnes, U.S. Fish and Wildlife Service, pers. comm. 1997). In Pennsylvania, four companies applied for sand and gravel mining permits in areas supporting massasauga populations in the same year (Andrew Shiels, Pennsylvania Fish & Boat Commission, pers. comm. 1997). One of Ohio's largest populations (Killdeer Plains) was bulldozed and plowed-under in 1994. More recently, a sizeable area that included hibernation and gestation habitat in Pennsylvania was converted from grassland to row-crop agriculture (Benjamin Jellen, St. Louis University, pers. comm. 2008).

In addition, urban encroachment has disrupted the natural disturbance processes (such as hydrological cycles and fire frequency), and subsequently, changes in habitat structure and vegetative composition have occurred. Under these circumstances, habitat becomes unsuitable for the species and contains dense stands of woody vegetation dominated by invasive species such as Eurasian buckthorn. For example, in New York, eastern massasaugas relate spatially with areas where woody stems are in low density (Johnson 1995, pp. 43-46). In Pennsylvania increasing woody vegetation was cited as a threat at 75 percent of the massasauga sites surveyed (Reinert and Buskar 1993, p. 57), and in Illinois the Service has worked with county forest preserve districts to enhance occupied habitat by funding habitat management and tile surveys (K. Lah, Endangered Species Coordinator, U.S. Fish and Wildlife Service 2009 Pers. Comm.).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

The over-collection of massasaugas is well documented, and the effects of past anti-rattlesnake campaigns are still visible today. Several populations have been collected beyond a recoverable threshold, and thus are functionally extinct. Intentional killing and illegal often collection continue in some states, despite many years of legal protection (Christiansen 1993, pp. 13-14). Law enforcement actions involving individuals from several states revealed the immediacy and magnitude of this threat. An Indiana Department of Natural Resources law enforcement investigation in 1998 uncovered a well-organized, multi-state effort to launder State-protected reptile species (including eastern massasauga). The investigation concluded with the indictment of 40 defendants. In 2009, a similar joint investigation by law enforcement agents in the United States and Canada uncovered at least 33 eastern massasaugas poached from a Canadian population, and then smuggled into the United States (New York Department of Environmental Conservation, 2009, web page).

C. Disease or predation.

Predation under natural conditions is not a notable threat for eastern massasauga. However, due to habitat loss as described under Factor A, eastern massasauga populations are extremely vulnerable to predators and as a result they experience abnormally high predation rates. Further, the female cohort is most susceptible because they spend more time in the open to maintain higher body temperatures when carrying young. Loss of pregnant females exacerbates the

impacts of predation. Little is known about naturally occurring disease in the eastern massasauga. A recent study that surveyed for exposure to West Nile Virus (WNV) and Ohphidian Paramyxovirus (OPMV) in a wild population in Illinois detected no exposure to WNV (Allender et al. 2006, p. 107). Though all individuals tested were seropositive for OPMV (Allender et al. 2006, p. 107), various factors other than direct exposure to the virus could have influenced these results (Allender et al. 2006, p. 111; Allender et al., 2008, p. 358-361).

D. The inadequacy of existing regulatory mechanisms.

Eastern massasauga is listed as endangered in Illinois, Indiana, Iowa, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wisconsin; as threatened in Ontario; and as special concern in Michigan. Although the subspecies is afforded some level of state protection across its range, protection of its habitat is nearly nonexistent. Given the significance and pervasiveness of habitat loss, the decline of eastern massasauga will continue without additional protections.

E. Other natural or manmade factors affecting its continued existence.

The thermoregulatory behavior of the gravid cohort render female massasaugas most vulnerable to collection, predation, and other sources of mortality. This species is viviparous, and gravid females at some sites are known to congregate in areas that allow them to maintain body temperatures that are optimal for gestation. Also, females do not bear their first litter until three years of age, or older, and then do so only once every other year. This low biological replacement rate means that eastern massasauga populations occurring at low densities are particularly sensitive to losses, both natural (e.g. predation) and human (e.g. collection or mortality due to land use practices). Thus, premature death or loss of just a few individuals could greatly diminish a population's reproductive potential. Similarly, two studies using a population viability analysis indicated that eastern massasauga populations are most sensitive to adult mortality (Seigel and Sheil, 1999, pp. 19-20; M. Dreslik, Illinois Natural History Survey, pers. comm. January 2007). Given the species' low biological replacement rate, even small increases in adult mortality can lead to irreversible declines. These biological traits and the threat factors identified above interact synergistically, which exacerbates the effect of individual factors and can lead to an extinction vortex for those populations affected by one or more factors.

Future climate change is one of several factors believed to be actively leading to declines in reptile populations (Gibbons et al. 2000, p. 654). Climate change may affect reptiles through a variety of factors, including altered precipitation regimes, food shortages, phenological shifts, or by changing incubation/gestation patterns (Gibbons, et al. 2000, pp. 654, 660). While any of these could affect the eastern massasauga, there is no data specific to this subspecies. To date most literature on the effects of climate change on vipers (including the eastern massasauga) centers on hypotheses that past climate change cycles (esp. cooling), or occurrence in cool climates influenced the evolution of modes of parity, and that viviparous species diversified at a greater rate during cooling cycles than did oviparous species (Lynch 2009, p. 2457). This theory implies that viviparity allows females to more closely regulate incubation conditions through their behavior (Lourdais et al. 2004, p. 551; Lynch 2009, p. 2458; Masden and Shine 1992, p. 40-47; Shine 2004, p.145). In addition to physiological or evolutionary effects, climate change may also affect the habitat of the eastern massasauga. It is believed that climate change will promote

the expansion of invasive plant species (Thuiller et al. 2007, pp. 197, 200). If this is the case, enhanced invasion/range expansion of invasive woody species in particular could increase the magnitude of this threat to the habitat of eastern massasauga.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED:

Management and monitoring guidelines for *S. c. catenatus* were developed under Region 3 guidance and made available as *The Eastern Massasauga Rattlesnake: A Handbook for Land Managers* in 2000. This handbook was broadly distributed and is currently being used by public land managers to assist them in developing candidate conservation agreements. As population data are limited at most sites, these conservation efforts are in the initial stages of information gathering. In Wisconsin, for example, limited resources were dedicated to completing exhaustive surveys and a telemetry study in the lower Chippewa River area in Buffalo County. Continued survey efforts are planned at this site and others.

We expect to gather status information at several priority sites rangewide and efforts will focus on developing and implementing Candidate Conservation Agreements (CCAs) for these populations. In 2004, a CCA with the Lake County Forest Preserve District in Illinois was completed. In 2005 a CCA with the Forest Preserve District of Cook County in Illinois was completed. In 2006, a Candidate Conservation Agreement with Assurances (CCAA) with the Ohio Department of Natural Resources Division of Natural Areas and Preserves was completed for Rome State Nature Preserve in Ashtabula County. State-wide and/or site-specific CCAs and CCAAs are currently being developed in Iowa, Illinois, Michigan, and Wisconsin. Several of these CCAs should be implemented in 2008-2009. The following, is a brief listing of ongoing actions being taken as part of the region-wide massasauga conservation initiative.

Illinois Carlyle Lake Project:

- Conducting surveys and radio-telemetry work at Carlyle Lake (Clinton County) to determine spatial & temporal habitat use. The 2009 field season will be the eleventh consecutive year of this research.
- Developing a CCA for the Carlyle Lake population.

Northeast Illinois Project:

- Conducting surveys and habitat management assessments in Lake (Ryerson Forest Preserve), Cook [Potawatami Woods, Dam Number 1 Woods (two areas to include the Willow/Sanders tract), Plumb Creek Forest Preserve, and Jurgenson Woods Forest Preserve], and Will (Goodenow Grove Forest Preserve) Counties.
- Continuing habitat management actions as needed at the sites in Lake, Cook and Will Counties.
- Participating in the completion of an agreement with the Association of Zoos and Aquariums (AZA), Forest Preserve District of Cook County, Forest Preserve District of Lake County, and the Illinois Department of Natural Resources to capture, house and breed eastern massasauga rattlesnakes from a non-recoverable population in northeastern Illinois.

Indiana

- Developing and distributing education/outreach materials (including brochure and recommendations of how to approach landowners) for region-wide use.

Iowa Sweet Marsh Wildlife Management Area

- Conducting radio telemetry studies at Sweet Marsh Wildlife Management Area (WMA) in Bremer County.
- Contacting pertinent private landowners adjacent to Sweet Marsh WMA.
- Developing a CCA for Sweet Marsh population.

Michigan

- Conducting ongoing surveys in known and potential massasauga areas to identify "core" protected properties in the following counties: Alcona, Allegan, Alpena, Barry, Benzie, Berrien, Calhoun, Cass, Cheboygan, Clinton, Crawford, Emmet, Huron, Iosco, Jackson, Kalamazoo, Kalkaska, Lapeer, Lenawee, Livingston, Mackinac, Manistee, Missaukee, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oceana, Ogemaw, Presque Isle, Roscommon, Sanilac, St. Joseph, Van Buren, and Washtena.
- Conducting a habitat characterization for massasauga in Michigan.
- Developing a state-wide umbrella CCAA document.

Minnesota

- Conducting surveys along the Mississippi River floodplains in Houston, Wabasha, and Winona counties to determine eastern massasauga presence in this area.

Missouri

- Investigating receptivity of Pershing State Park and pertinent adjacent landowners to conservation efforts on their lands and if receptive, developing CCA documents.
- Conducting surveys in other areas in the State to further define massasauga presence in Missouri.

Ohio

- Conducting relative abundance surveys at Rome and Pallister Nature Preserves in Ashtabula County.
- Developed CCAA document for Pallister Nature Preserve.

Wisconsin

- An analysis of the vegetation and hydrologic conditions of the Chippewa River Bottoms was completed to determine the extent of change that has occurred since 1939.
- Conducting a 4-year status survey and telemetry study to aid in the development of a CCA for Chippewa River Bottoms and Black River populations in Buffalo, LaCrosse, Pepin, and Trempealeau counties.

Because subspecific boundaries in the Massasauga are poorly defined and morphological variation appears clinal, these factors are of little use in diagnosing subspecies. This inability to morphologically diagnose populations has direct implications for the Endangered Species Act listing process and, subsequently, for management of the species and the enforcement of state and federal laws relating to collection and take. To address this problem, in June 2004, Region 3 provided Candidate Conservation flex funding towards a phylogenetic study comparing *S. c. catenatus* and *S. c. tergeminus*. Preliminary data indicate that the existing taxonomy may not accurately reflect the existing evolutionary patterns and diversity within this group, though the study is ongoing and we will await publication of the complete results in a peer-reviewed scientific journal.

Environmental awareness and public outreach efforts are being implemented throughout the massasauga's eastern range. In 2003, Region 3 of the Service published and helped to distribute

a 10-page, full-color, educational brochure entitled “*Live and Let Live: People and the Eastern Massasauga Rattlesnake*,” which was developed in conjunction with the Indiana Department of Natural Resource’s Wildlife Diversity Section. Because demand for these brochures has been high, Region 3 is currently making arrangements to have additional copies printed. In addition, multiple fact sheets about massasaugas remain available on the Region 3 internet site (<http://midwest.fws.gov/Endangered/lists/candidat.html>).

SUMMARY OF THREATS:

Habitat loss is an important factor in the decline of eastern massasauga. The effects of past, widespread wetland loss continue to impact eastern massasauga populations. Development and agriculture practices continue to perpetuate habitat loss, although to a lesser degree than in the past. However, recent information indicates that loss of suitable habitat area may be occurring where invasive woody vegetation is altering the vegetative structure of massasauga habitat, even at some protected sites. We are evaluating the magnitude of this potentially increasing threat. In general, habitat loss increases the distance between populations and can isolate seasonally used habitats within individual populations. Consequently, eastern massasauga populations become more susceptible to road mortality, predation, and persecution as snakes disperse from populations or make their seasonal movements between habitat types

The biological traits and the threat factors identified above interact synergistically, which exacerbates the effect of individual factors and can lead to an extinction vortex for those populations affected by one or more factors. We find that this subspecies is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

RECOMMENDED CONSERVATION MEASURES:

Since many extant populations of this species occur on preserves or otherwise protected tracts of habitat, as well as adjoining private property, we recommend that state, local, or non-government agencies, or private landowners responsible for massasauga habitat explore the possibility of entering Candidate Conservation Agreements (CCA) or Candidate Conservation Agreements with Assurances (CAAA) with the Service. CCAs or CCAAs allow the partner agency or landowner to work cooperatively with the Service to identify land management measures that would be beneficial to the species. Examples of such actions include: wetland and other habitat restoration activities or control of invasive species to improve habitat for massasaugas, strategic roadside mowing to discourage snake use of areas around roads, reduce likelihood of mortality by adjusting prescribed burn prescriptions or other land management activities for times when massasaugas are dormant. In addition to proactive land management practices, we also recommend outreach activities that might lessen public persecution of this relatively secretive, but venomous snake.

LISTING PRIORITY

Determination of Listing Priority Number

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9*
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

The magnitude of threats is considered “moderate” at this time. About 59 percent of extant populations occur wholly or in part on public lands, many of which are currently preparing CCAs that will protect the snakes in perpetuity. As land managers are becoming better educated, management practices that conflict with massasauga conservation are being addressed. As a result of public outreach efforts and simple word-of-mouth, many adjacent private landowners are also becoming aware of the need and importance for them also to follow massasauga-friendly management on their properties. However, populations soon to be under CCAs and CCAAs have a low to moderate likelihood of persisting and remaining viable. Other populations are likely to suffer additional losses in abundance and genetic diversity and some will likely be extirpated unless threats are removed in the near future. Declines have continued or may be accelerating in several states. Thus, we are monitoring the status of this species to determine if a change in listing priority is warranted. Furthermore, we are working with several experts and partners in the development of an extinction risk model for the subspecies and these results may indicate that a change in listing priority number is appropriate.

Imminence:

Threats of habitat modification, habitat succession, incompatible land management practices, illegal collection for the pet trade, and human persecution are ongoing and thus remain an imminent threat to many remaining populations, particularly those located on private lands.

YES Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted?

No. Emergency listing is not warranted at this time because approximately 59 percent of populations occur wholly or in part on public lands, and many of the land managers are currently preparing CCAs and/or voluntarily practicing massasauga-friendly management practices.

DESCRIPTION OF MONITORING:

Throughout the year, Service biologists informally coordinate with other Service biologists within Regions 3 and 5, as well as with state and provincial biologists, state endangered species program staff, and other species experts throughout the range of the subspecies. See *Sistrurus c. catenatus* Rangewide Status Assessment (1998) for a list of individuals frequently contacted.

In addition, the Service's Endangered Species Program Coordinators from each state in Region 3 join their counterparts from the state wildlife agencies each fall for a 3-day coordination meeting. During this annual meeting, recently completed and/or ongoing monitoring efforts, survey results, and conservation activities and concerns regarding massasaugas are discussed.

Because the Service has provided funding to several states for gathering baseline data and for investigating and developing CCAs, new and updated data are being generated for many populations. The Service is receiving this information in the form of annual/interim reports and population updates from these recent and/or ongoing regional survey efforts. Another source of information has been from the scientific literature, especially now that the Service has on-line access to numerous scientific journals.

We believe this level of monitoring is appropriate, given the biology of the species and the threats it faces.

COORDINATION WITH THE STATES:

In preparing this document, we have consulted with local species experts, biologists, or program administrators from state and local governments, as well as Service field offices, regional offices, or national wildlife refuges known to have eastern massasauga populations, in all states within the species range (IA, IL, IN, MI, MN, MO, NY, OH, PA, and WI). In addition, eastern massasauga is included in State Wildlife Action Plans in every state across the species range.

LITERATURE CITED:

- Allender, M.C., M.A. Mitchell, C.A. Phillips, K. Gruszynski, and V.R. Beasley. 2006. Hematology, plasma biochemistry, and antibodies to select viruses in wild-caught eastern massasauga rattlesnakes (*Sistrurus catenatus catenatus*) from Illinois. *Journal of Wildlife Diseases*, 42: 107–114
- Allender, M.C., M.A. Mitchell, M.J. Dreslik, C.A. Phillips, and V.R. Beasley. 2008. Measuring agreement and discord among hemagglutination inhibition assays against different ophidian paramyxovirus strains in the eastern massasauga (*Sistrurus catenatus catenatus*). *Journal of Zoo and Wildlife Medicine* 39: 358–361
- Christiansen, J.L. 1993. Survey for New Populations of the Eastern Massasauga Rattlesnake, *Sistrurus catenatus catenatus* in Eastern Iowa. Final Report submitted to Iowa Department of Natural Resources. 38pp.
- Conant, R., J. Collins. 1998. Peterson Field Guides: Reptiles and Amphibians (Eastern/Central North America). New York, NY: Houghton Mifflin Harcourt Company. Fourth Edition, 640pp.
- Gibbons, J.W., D.E. Scott, T.J. Ryan, K.A. Buhlmann, T.D. Tuberville, B.S. Metts, J.L. Greene, T. Mills, Y. Leiden, and C.T. Winne. 2000. The global decline of reptiles, *déjà vu* amphibians. *BioScience* 50: 653-666.
- Gloyd, H.K. 1940. The rattlesnakes, genera *Sistrurus* and *Crotalus*. *Chicago Acad. Sci. Spec. Publ.* (4):1-266
- Johnson, G. 1995. Spatial Ecology, Habitat Preference, and Habitat Management of the Eastern Massasauga, *Sistrurus c. catenatus* in a New York Weakly-Minerotrophic Peatland. Dissertation. State University of New York, College of Environmental Science and Forestry, Syracuse, New York. 222 pp.
- Legge, J.T. 1996. Final Report on the Status and Distribution of the Eastern Massasauga Rattlesnake (*Sistrurus catenatus catenatus*) in Michigan. Unpublished report for U.S. Fish and Wildlife Service, Twin Cities, MN. 17 pp + appendices.
- Lourdais, O., R. Shine, X. Bonnet, M. Guillon, G. Naulleau. 2004. Climate affects embryonic development in a viviparous snake, *Vipera aspis*. *Oikos* 104:3, 551-560
- Lynch, V.J. 2009. Live-birth in vipers (Viperidae) is a key innovation and adaptation to global cooling during the Cenozoic. *Evolution* 63: 2457-2465.
- Madsen, T., and R. Shine. 1992. Determinants of reproductive success in female adders, *Vipera berus*. *Oecologia* 92: 40-47
- Mierzwa, K.S. 1993. Habitat Utilization and Status of the Eastern Massasauga Rattlesnake, *Sistrurus catenatus catenatus*, in the Chicago Region. Pages 66-70 in B. Johnson and V. Menzies

(eds.), Proceedings of the International symposium and workshop on the conservation of the eastern massasauga rattlesnake *Sistrurus catenatus catenatus*. Metro Toronto Zoo, West Hill, Ontario. 141pp.

Minton, S.A., Jr. 1972. Pages 315-319 in *Amphibians and Reptiles of Indiana*. Indiana Academy of Science, Indianapolis.

Minton, S.A., Jr. 1983. *Sistrurus catenatus*. SSAR Catalog. Amer. Amphib. Rept. 332:1-2.

New York Department of Environmental Conservation. 2009. Black market animal trade busted. DEC's in-depth undercover investigation nets 18 arrests.
<<http://www.dec.ny.gov/press/52868.html>>

Reinert, H.K., and L.M. Buskar. 1993. The massasauga rattlesnake in Pennsylvania: continuing habitat loss and population isolation. Pp. 55-59 in B. Johnson and V. Menzies (eds.), Proceedings of the International symposium and workshop on the conservation of the eastern massasauga rattlesnake *Sistrurus catenatus catenatus*. Metro Toronto Zoo, West Hill, Ontario. 141pp.

Seigel, R. A. and C. A. Sheil. 1999. Population Viability Analysis: Applications for the conservation of massasaugas. Pp.17-22 In: Second International Symposium and Workshop on the conservation of the eastern massasauga rattlesnake, *Sistrurus catenatus catenatus*: Population and habitat management issues in urban, bog, prairie, and forested ecosystems. Bob Johnson and Mark Wright, editors. Toronto Zoo, Toronto, Ontario.

Shine, R. 2004. Incubation regimes of cold-climate reptiles: the thermal consequences of nest-site choice, viviparity and maternal basking. *Biological Journal of the Linnean Society* 83: 145-155.

Szymanski, J. 1998. Eastern Massasauga Rangewide Status Assessment. Unpublished report for U.S. Fish and Wildlife Service, Region 3, Fort Snelling, MN.

Thuiller, W., Richardson, D.M., and Midgley, G.F. 2007. Will climate change promote alien plant invasions? In: Nentwig, W. eds., *Biological Invasions, Ecological Studies*, Vol. 193, Springer-Verlag, Berlin Heidelberg, pp. 197-211.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Arti Worley
ACTING Regional Director, Fish and Wildlife Service

6/2/10
Date

Concur: Foran W. Gould
ACTING Director, Fish and Wildlife Service

Date: October 22, 2010

Do not concur _____
Director, Fish and Wildlife Service

Date

Director's Remarks:

Date of annual review:

Conducted by:

Comments: